

## Brackish-water Copepods of the Family Tachidiidae (Copepoda: Harpacticoida) from South Korea

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### ABSTRACT

Four harpacticoid species belonging to the family Tachidiidae are reported from the coastal waters and salt marshes in South Korea: *Tachidius discipes* Giesbrecht, 1881, *Neotachidius parvus* Huys, Ohtsuka, Conroy-Dalton and Kikuchi, 2005, *Microarthridion litospinatus* Shen and Tai, 1973 and *Geeopsis incisipes* (Klie, 1913). The latter two species and genera are new to Korean fauna. The previous record of *T. discipes* reported by Song and Chang (1995) from Korea is affirmed by the finding of male specimens. *Microarthridion litospinatus* is first known outside the type locality, and redescribed herein in detail. A key to the five species and four genera of the family Tachidiidae hitherto known from South Korea is presented.

**Key words:** Brackish-water Copepoda, Harpacticoida, Korea, Tachidiidae, taxonomy

### INTRODUCTION

The family Tachidiidae was one of the first to be recognized in the harpacticoid Copepoda as Boeck introduced the name Tachidina in 1865 (Huys et al., 2005). Only 13 species of six genera are currently recognized in this family. Although the family is rather small, majority of the hitherto-recorded species are known as common, especially in the neritic waters of high latitudes in the northern hemisphere, showing rather big population size as coastal zooplanktons. They are in general euryhaline, so often found in brackish waters such as estuaries and coastal marshes, and some species even extend to freshwaters.

In Korea, Song and Chang (1995) first reported two species belonging to the family, *Tachidius discipes* Giesbrecht, 1881 and *T. (Neotachidius) triangularis* Shen and Tai, 1963 (= *Neotachidius parvus* Huys, Ohtsuka, Conroy-Dalton and Kikuchi, 2005) from Jindo Island. Huys et al. (2005) elevated the subgenus *Neotachidius* to genus level, and described two new species, *N. parvus* and *N. coreanus*, from the brackish waters of Gwangyang Bay. They considered *T. discipes* Giesbrecht *sensu* Song and Chang, 1995 as a *species inquirenda* in the genus *Sinotachidius*, and also suggested that *N. triangularis sensu* Song and Chang, 1995 was at least partly based on *N. parvus*.

As one of the serial researches on the brackish-water copepod fauna, the authors have examined the harpacticoid specimens deposited in the specimen room of the Department of Biological Science, Daegu University. As a provisional

result, four species of four genera belonging to the family Tachidiidae are identified, comprising *T. discipes*, *Neotachidius parvus* Huys, Ohtsuka, Conroy-Dalton and Kikuchi, 2005, *Microarthridion litospinatus* Shen and Tai, 1973 and *Geeopsis incisipes* (Klie, 1913). As *M. litospinatus* is first known outside the type locality, southern China, and the original description is insufficiently made, I redescribe it in detail herein. Illustrations for another new record, *G. incisipes*, and the other two recorded species are also prepared, with the brief comments on the previous records by Song and Chang (1995).

### MATERIALS AND METHODS

Materials examined in the present study were collected from the various brackish-waters such as coastal marshes, estuaries, and brackish-water lakes in South Korea since 1988. Collections were made with a plankton net and a dipnet of 64 µm mesh. Copepods were fixed and stored in 4% buffered formalin.

Specimens were dissected and mounted in lactophenol on H-S slide, after the treatment in a solution of 5% glycerin-95% ethyl alcohol for 1-2 days. Dissection is performed using two needles made from 0.25 mm diameter tungsten wire by electrolysis (Huys and Boxshall, 1991). Dissected specimens were observed under a differential interference contrast microscope (Olympus BX51) with Nomarski optics. Figures were prepared with the aid of a camera lucida. Measurements were done with a digital camera for microscope (Cool SNAP 5.0M, Roper Scientific Co., U.S.A.) and a calibration software QCapture Pro (ver. 5.0, Media Cybernetics

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Inc., U.S.A.).

Abbreviations used in the text and figure legend follow the conventional ones frequently used in the taxonomy of copepods: A1, antennule; A2, antenna; enp 1-3 or exp 1-3, the first to third endopodal or exopodal segment of each leg; Fu, caudal rami; P1-P6, first to sixth pereopods (thoracic legs).

## SYSTEMATIC ACCOUNTS

Family Tachidiidae Boeck, 1865

Genus <sup>1</sup>*Tachidius* Lilljeborg, 1853

<sup>2</sup>*Tachidius discipes* Giesbrecht, 1881 (Fig. 1)

*Tachidius discipes* Giesbrecht, 1882, p. 108 (cited from Lang, 1948); Lang, 1948, p. 292, fig. 143: 1; Dussart, 1967, p. 172, fig. 61; Mielke, 1975, p. 40, fig. 23.

*Tachidius (Tachidius) discipes*: Tai and Song, 1979, p. 193, fig. 88; Song and Chang, 1995, p. 66, fig. 1.

**Material examined.** Six ♀♀ (1 ovi.), 7♂♂, Cheongchoho Lake, Sokcho, 28 Dec. 2006 (C.Y. Chang and J.M. Lee).

**Ecology.** Known as eurythermic and euryhaline species, usually inhabiting brackish waters or neritic zone, and often co-occurring with freshwater species. In Cheongchoho Lake, a brackish-water lake situated at the eastern coast of South Korea, this species co-occurred with *Eurytemora affinis* (Calanoida), *Nitokra koreanus*, *Schizopera clandestina* (Haracticoida), *Oithona davisae* and *Halicyclops* sp. (Cyclopoida).

**Distribution.** Europe, North America, Kuril Islands, Sakhalin, China, and Korea.

**Remarks.** Huys et al. (2005) considered *T. discipes sensu* Song and Chang, 1995 from Jindo Island as a *species inquirenda* in the genus *Sinotachidius*. As Song and Chang (1995) relied on female specimens only, and the specimens are lost, the record cannot have been confirmed.

*Sinotachidius vicinospinalis* (Shen and Tai, 1964) described from southern China is somewhat similar to *T. discipes* in the female characters such as the bilobed P5 with its setal arrangement and the armature of swimming legs. In female, *S. vicinospinalis* is discernible from *T. discipes* by having only 2 apical setae on the distal segment of A2 exopod (against 1 lateral and 2 apical setae in *T. discipes*). However, the lateral seta in *T. discipes* sometimes seems to be reduced according to populations. The lateral seta on A2 exp 2 in all the specimens from Cheongchoho Lake is consistently reduced, and even vestigial (Fig. 1C, arrow), which is reminiscent of the figure (Huys et al., 1996, fig. 88B)

based on the specimen from the North Sea (maybe around U.K.).

*Sinotachidius* is distinctly different from *T. discipes* by the sexually dimorphic characters in male, especially the shape of projection on P2 enp 2 (cf. Fig. 1F, arrow), the armature of P2 enp 3 (2 pinnate apical setae and 1 slender seta in *T. discipes*, while 2 inner and 1 apical setae with 2 small outer distal elements in *S. vicinospinalis*), and the number of inner setae of P5 (3 setae in *T. discipes*, against 2 in *S. vicinospinalis*). The male specimens from Cheongchoho Lake fit precisely with European specimens of *T. discipes*.

Genus <sup>3</sup>*Neotachidius* Shen and Tai, 1963

<sup>4</sup>*Neotachidius parvus* Huys, Ohtsuka, Conroy-Dalton and Kikuchi, 2005 (Fig. 2)

*Tachidius (Neotachidius) triangularis* Shen and Tai, 1963 *sensu* Song and Chang, 1995, p. 66, fig. 2.

*Neotachidius parvus* Huys, Ohtsuka, Conroy-Dalton and Kikuchi, 2005, p. 147, figs. 11-15, 16B.

**Previous records.** Jindo Is. (Song and Chang, 1995) and Gwangyang Bay (Huys et al., 2005).

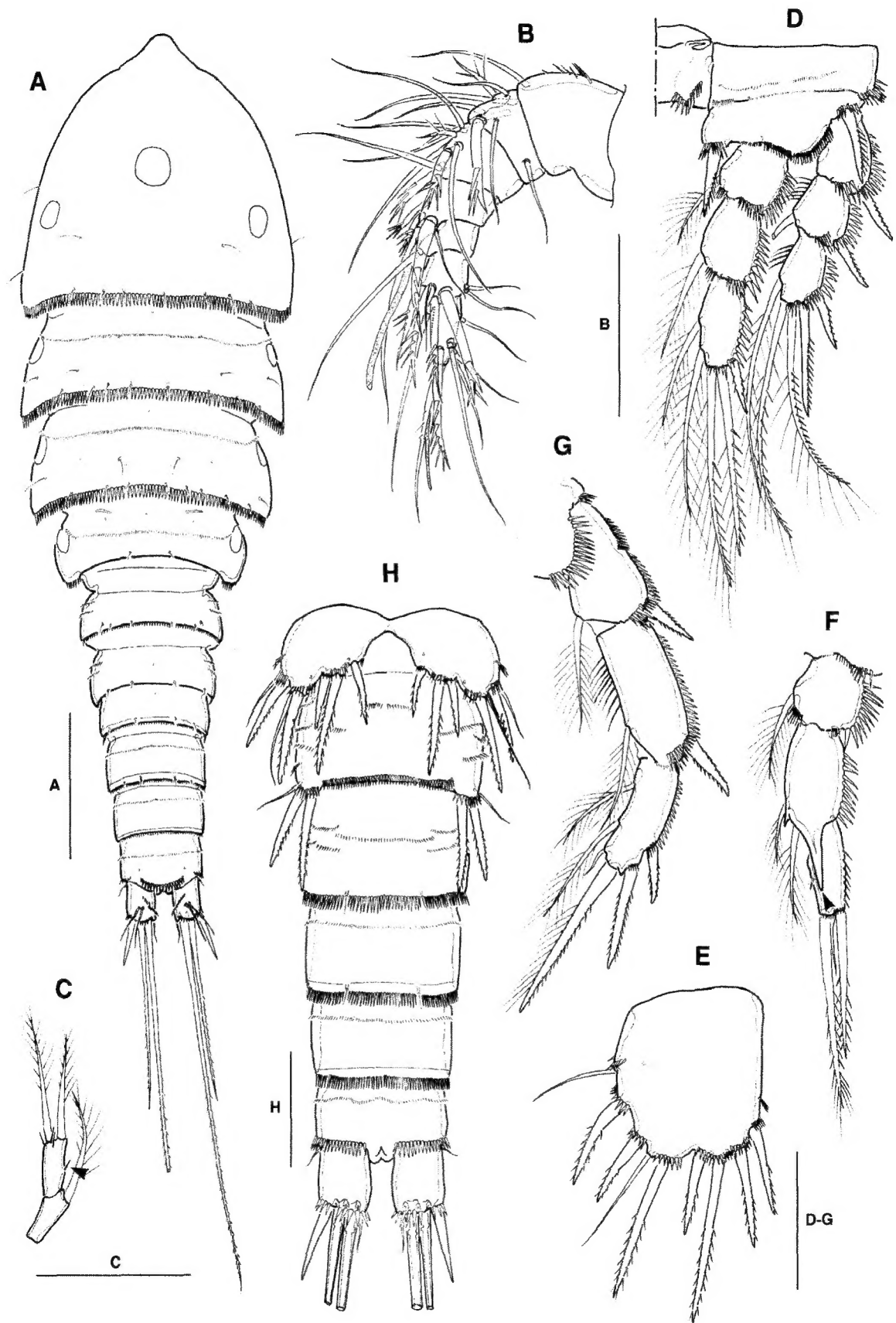
**Material examined.** Four ♀♀, 2♂♂, Daeho Tidal Embankment, Seosan, 28 Apr. 1992 (C.Y. Chang); 3 ♀♀ (ovi.), Muchangpo (salt marsh), Boryeong, 1 May 2007 (C.Y. Chang and H.J. Yoon); 5 ♀♀, Janghang, 2 May 1992 (C.Y. Chang); 2 ♀♀, 1♂, Taehwagang R., Ulsan (Myeongchongyo Br.), 29 Jan. 2005 (J.M. Jeon); 3 ♀♀ (2 ovi.), 1♂, same locality, 31 Mar. 2007 (C.Y. Chang); 1 ♀, 1♂, Dangyun tidal embankment, Changseondo Is., Namhae, 20 Sep. 2004 (C.Y. Chang); 2 ♀♀ (1 ovi.), 1♂, Hadong (lower reaches of Seomjingang R.), 9 Oct. 2005 (C.Y. Chang and J.M. Lee); 4 ♀♀ (1 ovi.), 1♂, estuary of Gwangogcheon Str., Hadong, 26 Apr. 2007 (C.Y. Chang, J.M. Lee and H.J. Yoon); 2 ♀♀, 1♂, Jinwol (reed marsh), Gwangyang, 2 Feb. 2005 (H.W. Lim); 1 ♀, 1♂, Seogjang-ri, Wando Is., 17 Oct. 1995; 2 ♀♀ (1 ovi.), 1♂, Gagyae-ri, Jindo Is., 23 Jul. 1994 (C.Y. Chang and S.J. Song); 2 ♀♀, Naesan-ri (streamlet), Jindo Is., 17 Oct. 2004 (J.M. Jeon and H.W. Lim); 1 ♀, Jodo Is. (Changyu tidal embankment), Jindo Is., 19 Oct. 2004 (J.M. Jeon and H.W. Lim); 2 ♀♀, 1♂, Jocheon, Jeju Is., 30 Oct. 1993; 4 ♀♀, 1♂, Jongdal-ri (swamp, ditch), Seongsanpo, Jeju Is., 25 Jan. 2003 (C.Y. Chang and J.M. Lee).

**Ecology.** Brackish-water species, inhabiting estuaries and coastal marshes; supposedly euryhaline and rather planktonic. Many ovigerous females were collected in winter.

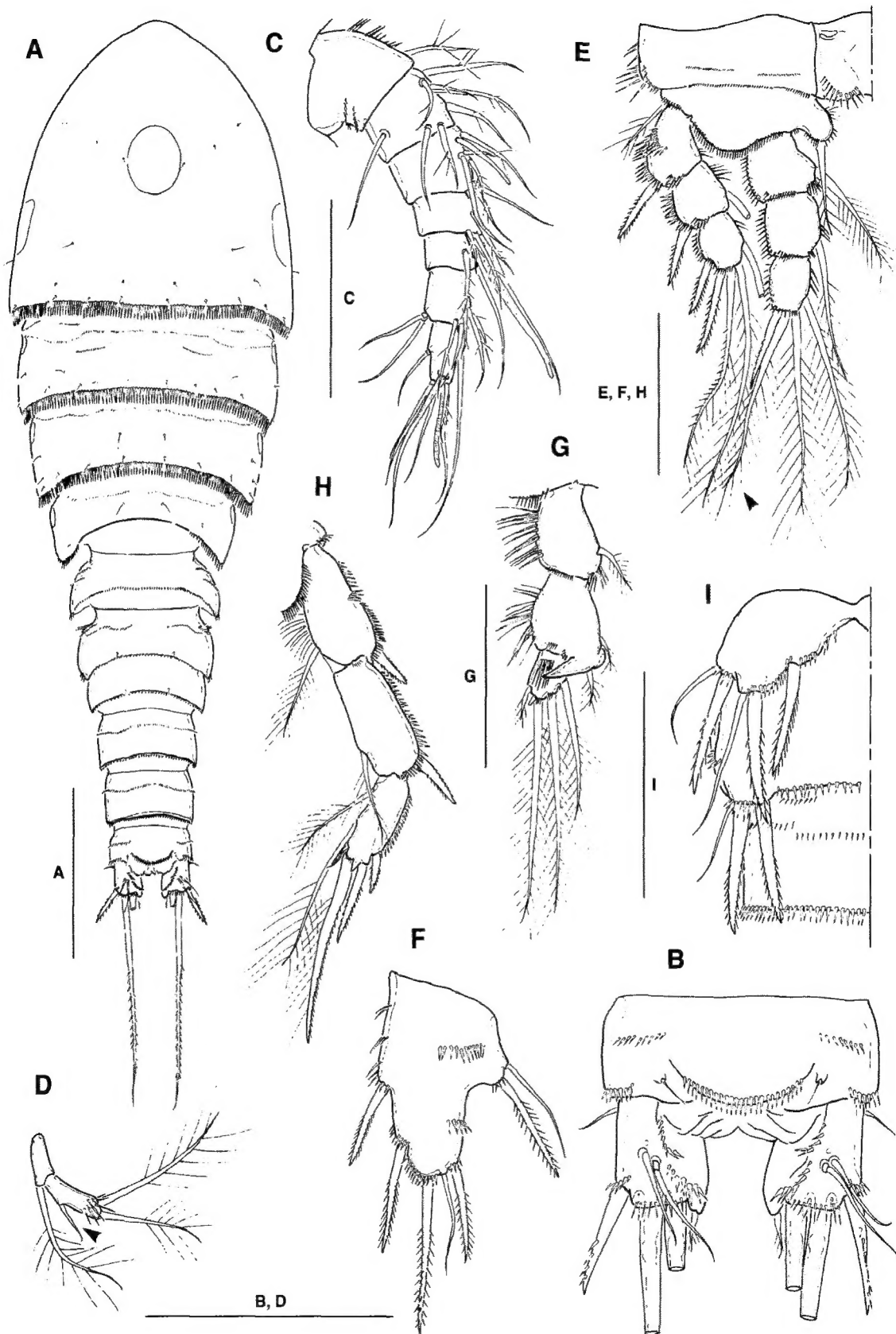
**Distribution.** South Korea (the Yellow Sea, South Sea, East Sea=the Sea of Japan, and Jeju Island).

**Remarks.** This species is most common and frequent in the

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**Fig. 1.** *Tachidius discipes* Giesbrecht. A-E, female: A, habitus, dorsal; B, A1; C, A2 exopod; D, P1; E, P5. F-H, male: F, P2 endopod; G, P3 exopod; H, urosome, P5 and P6, ventral. Scale bars=100  $\mu$ m (A), 50  $\mu$ m (B, D-H) and 30  $\mu$ m (C).



**Fig. 2.** *Neotachidius parvus* Huys, Ohtsuka, Conroy-Dalton and Kikuchi. A-F, female: A, habitus, dorsal; B, anal somite and Fu, dorsal; C, A1; D, A2 exopod; E, P1; F, P5. G-I, male: G, P2 endopod; H, P3 exopod; I, P5 and P6. Scale bars=100  $\mu$ m (A), 50  $\mu$ m (B-I).

brackish waters of South Korea. Korean specimens examined in this study coincide well with Huys et al.'s (2005) description. However, as shown in Fig. 2E based on a female specimen from Jeju Island, the inner distal seta on P1 basis often does not reach to the distal end of enp 2, and the outer margin of P1 coxa is often armed with long and sharp spinules as in *N. coreanus*.

As already discussed by Huys et al. (2005), *N. parvus* from Korea is consistently distinguished from *N. triangularis* (Shen and Tai, 1963) from Guangdong Province, southern China consistently by the following characters: (1) lateral seta on the distal segment of A2 exopod is slender and smooth (cf. Fig. 2D, arrow), while absent in *N. triangularis*; (2) the outer distal seta on P1 enp 3 is nearly as long as the adjacent seta (cf. Fig. 2E, arrow), while it is spiniform and much shorter than the adjacent seta in *N. triangularis*; (3) in male P3 exopod (cf. Fig. 2H), the length ratio of exp 2 to exp 3 is about 1.2, while about 1.7 in *N. triangularis*, and the ratio of apical seta to outer distal spiniform seta is about 2.2, while about 3.7 in *N. triangularis*; and (4) Fu lacks dorsolateral spinule row, while present in *N. triangularis*. I have re-examined more than 20 samples from 15 localities including Jindo Island, but failed to find the specimens of *N. triangularis*. At this point, the *N. triangularis sensu* Song and Chang, 1995 is most likely judged as an erroneous identification of *N. parvus*.

Huys et al. (2005) also described a sympatric species, *N. coreanus*, from Gwangyang Bay, South Korea. I examined some specimens from Taehwagang River, Ulsan and a few coastal lakes (or lagoons) on the East Sea, which generally fit with the description of Huys et al. (2005). However, some characters appeared as strongly variable, that is, the specimens examined sometimes have a reduced lateral seta on the distal segment of A2 exopod, and usually do not have the setule row on the posterior surface of P3 and P4 coxae in female. The identification of the specimens is deferred pending future study on the variability of *N. coreanus*.

Genus <sup>1</sup>\**Microarthridion* Lang, 1944

<sup>2</sup>\**Microarthridion litospinatus* Shen and Tai, 1973  
(Figs. 3-5)

*Microarthridion litospinatus* Shen and Tai, 1973, p. 369, figs. 1-11; Tai and Song, 1979, p. 178, fig. 93; Bodin, 1997, p. 46.

**Material examined.** Two ♀♀ (1 juvenile), 2♂♂, Changyu tidal embankment (coastal marsh), Jodo Is., Jindo, 19 Oct. 2004 (H.W. Lim and J.M. Jeon).

**Description. Male:** Body (Fig. 3A) with cyclopoid appear-

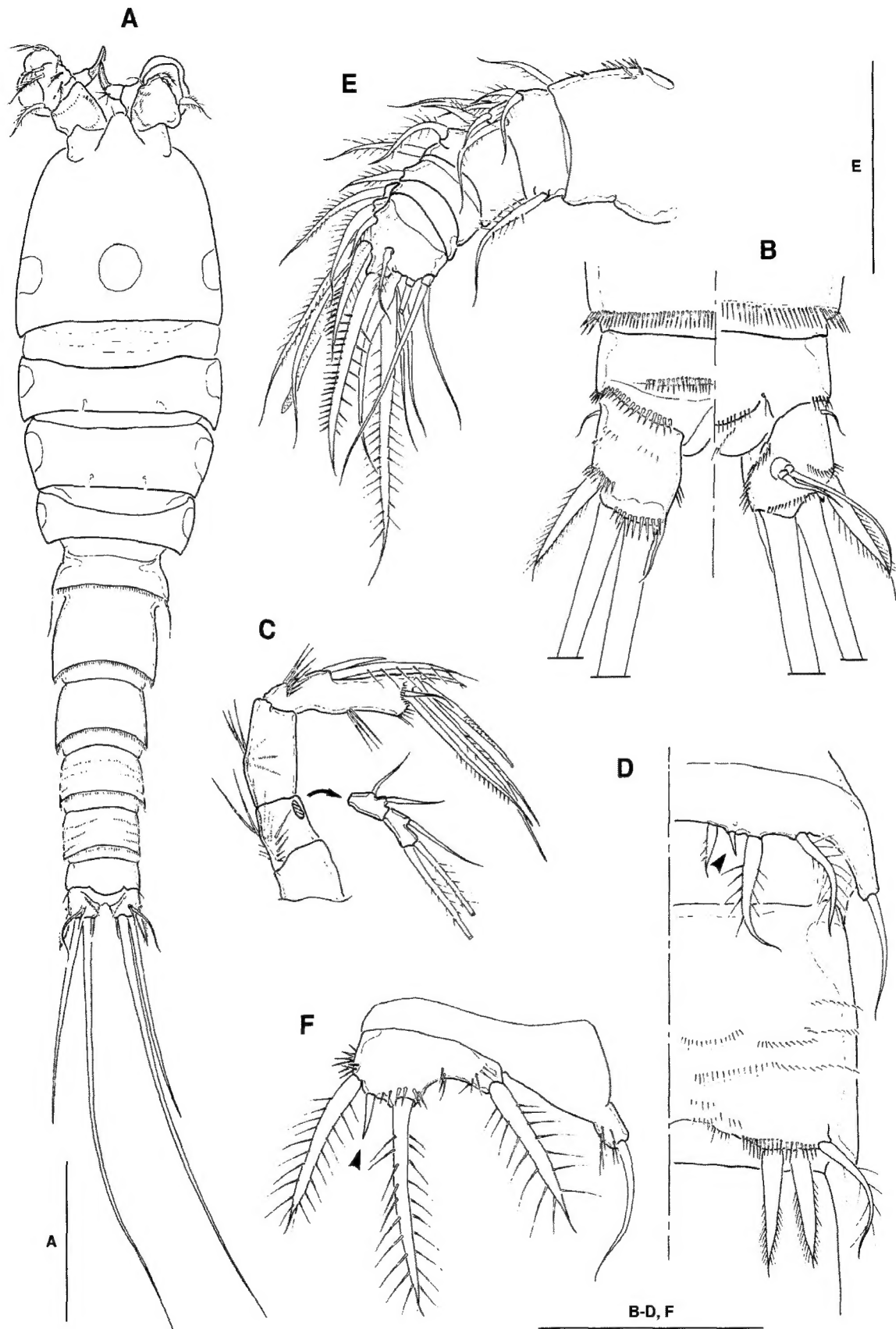
ance; rather small, 360-380 µm long, relatively narrower than females; tinged with pale brown; body heavily stuck with mud or fine sand particles; prosome ellipsoidal, urosome cylindrical. Cephalothorax nearly as long as sum of next 3 prosomites, with median nuchal organ and 2 lateral accessory nuchal organs. Rostrum a little protruding and its tip blunt, not defined at its base. Pedigers 2-4 each with paired accessory nuchal organs laterally; pediger 5 lacking accessory nuchal organ.

Anal operculum (Fig. 3B) semicircular with spinule row along posterior edge. Fu columnar, 1.1-1.3 times longer than wide, a little divergent posteriorly; armed with 1 oblique row of fine setules curving inward, and with row of sharp spinules ventrodistally. Lateral caudal seta small, locating near proximal end of lateral margin of Fu. Outer caudal seta stout and spiniform, about 2.5 times longer than inner caudal seta. Paired dorsal caudal setae issuing from small projection nearly in the middle of Fu.

A1 subchirocerate, 9-segmented; geniculate between segments 6 and 7; segment 7 swollen with 1 aesthetasc; last segment forming claw-like projection apically, with 1 distal aesthetasc. A2 (Fig. 3C) exopod 2-segmented; proximal segment with 2 naked setae, distal segment with 1 naked lateral seta and 2 plumose apical setae. Mandible (Fig. 4A) with well developed coxal gnathobase bearing several teeth along distal margin and 1 seta at dorsal corner; basis with 1 inner distal seta and setule row along medial margin; endopod with 2 pinnate inner setae and 5 apical setae; exopod armed with 2 inner, 2 apical and 1 outer distal setae. Prae-coxal arthrite of maxillule (Fig. 4B) bearing 6 spines and 1 pinnate seta along distal margin with 2 juxtaposed setae on frontal surface, and 2 setae (1 large pinnate and 1 naked) on caudal surface. Maxilla (Fig. 4C), syncoxa with 3 endites, proximal endite expanded distally with 4 pinnate setae, middle and distal endites each bearing 3 setal elements; allobasis forming 1 strong pectinate claw, flanked by 3 setae, with setule row along outer margin; endopod represented by small protuberance bearing 6 elements in total. Maxilliped (Fig. 4D) subchelate; syncoxa elongate, with spinule rows along both inner and outer margins and inner distal corner; basis not pectinate along inner margin; endopod 1-segmented, bearing 1 distal naked seta and 1 elongate claw equipped with 3-4 pairs of spinules as accessory armature.

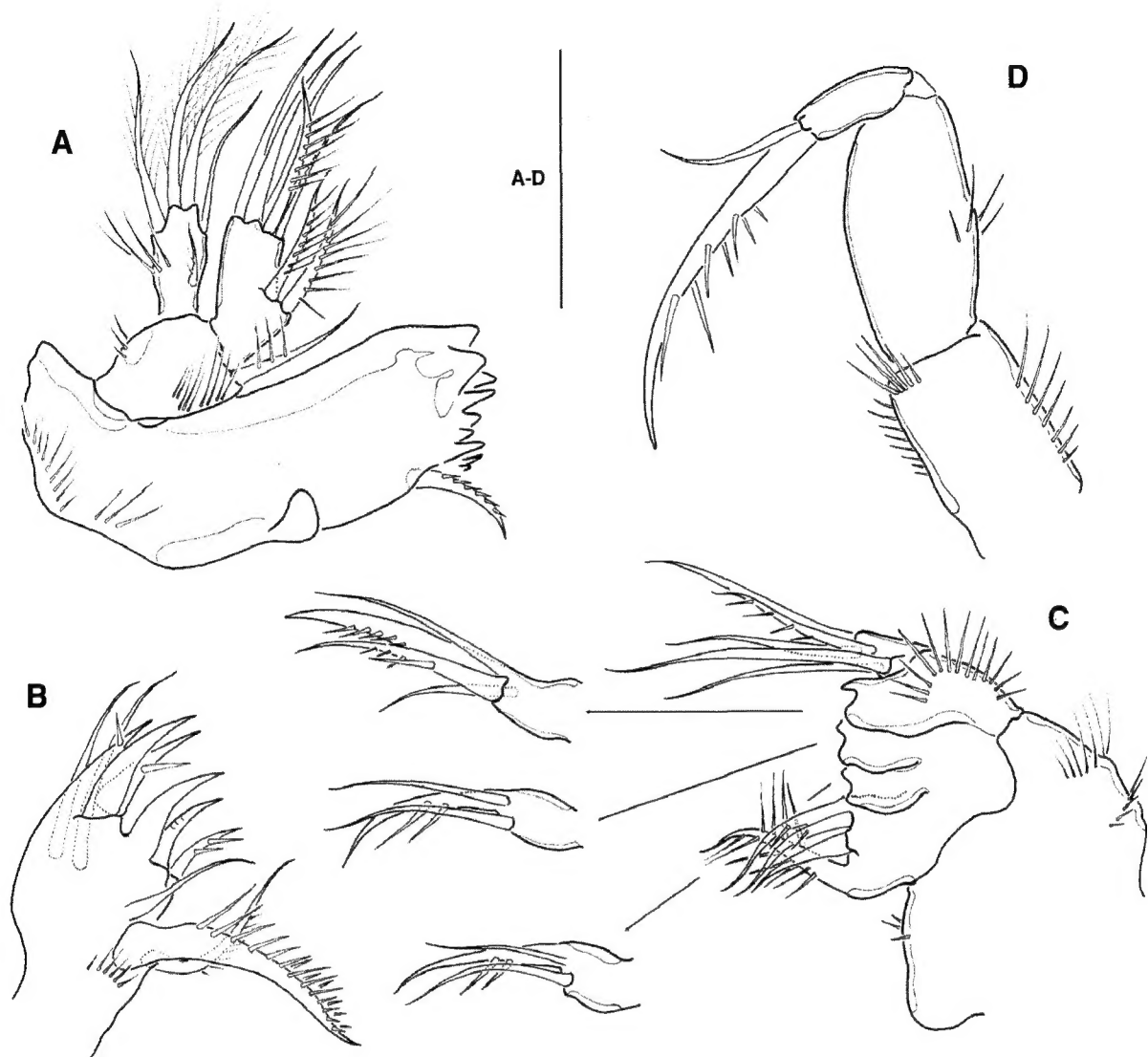
P1-P4 (Fig. 5A-D), both endopods and exopods 3-segmented; all enp 1 very small, lacking inner seta. P1 (Fig. 5A) similar in shape as other legs; basis with 1 pinnate spiniform seta distomedially, not showing sexual dimorphism distinctly (only a little longer and more slender than in female), its tip exceeding over middle of enp 2; endopod a little longer

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**Fig. 3.** *Microarthridion litospinatus* Shen and Tai. A-D, male: A, habitus, dorsal; B, anal somite and Fu, ventral (left) and dorsal (right); C, A2; D, P5 and P6. E, F, female: E, A1; F, P5. Scale bars=100  $\mu$ m (A), 50  $\mu$ m (B-F).





**Fig. 4.** *Microarthridion litospinatus* Shen and Tai, male. A, mandible; B, praecoxal arthrite of maxillule; C, maxilla; D, maxilliped. Scale bar=20  $\mu$ m.

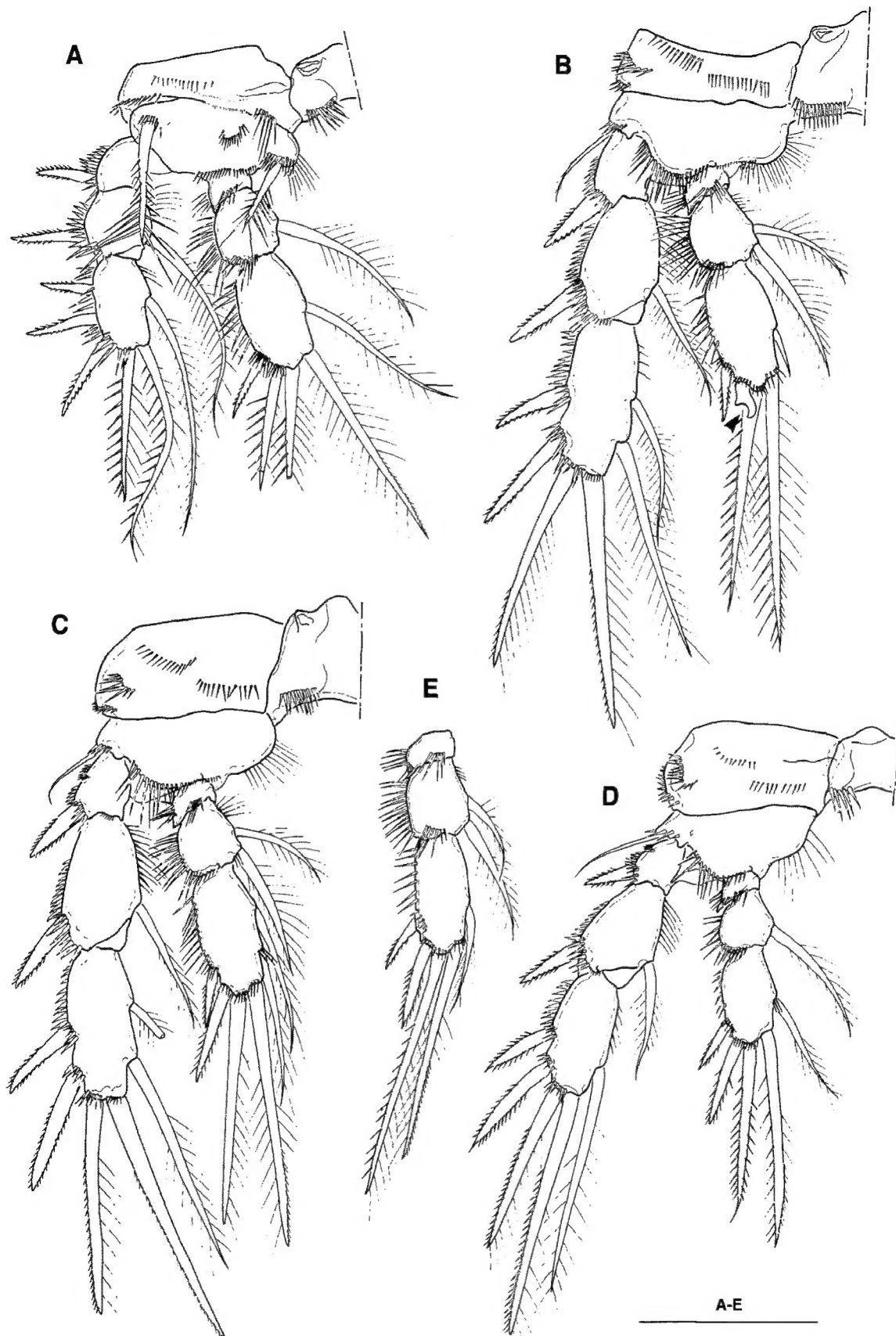
than exopod; outer distal setae of enp 3 pinnate, spiniform; exp 1 without inner seta; exp 3 with 3 outer spines, 2 pinnate apical and 1 plumose inner setae. P2 (Fig. 5B), enp 2 with 2 normal, plumose inner setae, not forming inner apophysis; enp 3 bearing 1 outer spine, 2 apical spiniform elements (outer one modified as crochet-like projection, as indicated with arrow in Fig. 5B), 1 long inner distal seta and 1 very short naked inner seta. P3 (Fig. 5C) not showing sexual dimorphism distinctly; outer distal seta on enp 3 short, spiniform. P4 (Fig. 5D), enp 2 with 1 inner seta; enp 3 bearing 1 short, spiniform outer distal seta.

Seta and spine armature of P1-P4 as follows (Arabic numerals representing setae, while Roman numerals indicating spines):

P1	basis 1-1	exp I-0; I-1; III,2,1	enp 0-0; 0-1; I,2,2
P2	basis 1-0	exp I-0; I-1; II,2,2	enp 0-0; 0-2; I,2,2
P3	basis 1-0	exp I-0; I-1; II,2,2	enp 0-0; 0-2; I,2,3
P4	basis 1-0	exp I-0; I-1; II,2,1	enp 0-0; 0-1; I,2,2

P5 (Fig. 3D) vestigial, represented by a small plate incorporated into pediger 5, bearing 4 elements (including 1 minute spine) along posterior margin of the somite, with 1 outer basal seta. P6 (Fig. 3D) represented by a small plate, fully incorporated into distolateral corner of genital somite, bearing 3 setae distally (including 2 stout spiniform setae medially).

*Female:* Body about 450  $\mu$ m long; prosome oval, urosome a little flattened dorsoventrally, tapering posteriorly; tinged with yellow-brown. All somites furnished with spinule row



**Fig. 5.** *Microarthridion litospinatus* Shen and Tai. A-D, male P1-P4; E, female P2 endopod. Scale bar=50  $\mu$ m.



along posterior margin. Sexual dimorphism shown in genital somite, A1, P2 and P5.

Genital somite and first abdominal somite fused to genital double-somite, with subcuticular chitinous rib marking line of fusion dorsally and laterally.

A1 (Fig. 3E) short and blunt, not reaching to proximal third of cephalothorax; 6-segmented; segment 1 armed with short spinules along anterior margin; segment 2 with 1 plumose seta on ventral margin; segments 4 and 5 small; segment 6 blunt, bearing 6 naked setae, and 6 plumose setae with 1 aesthetasc. Setal formula: 1-[1], 2-[7], 3-[4], 4-[2+aesthetasc], 5-[1], 6-[12+aesthetasc].

P2 endopod (Fig. 5E), outer distal spiniform seta not modified to crochet-like projection as in male, similar to those of P3 and P4.

P5 forming a plate-like inner lobe, bearing 3 pinnate setae and 1 minute spine (Fig. 3F, arrow) between innermost and median setae; basal sheath produced to a knob-like projection bearing 1 outer seta distally.

**Ecology.** Collected from a coastal marsh in Jodo Is., Jindo, southwestern coast of the Korean Peninsula, co-occurred with *Tachidius parvus* and *Eucyclops ohtakai* (Cyclopoda).

**Distribution.** Southern China (Fuchen Province) and Korea (Jindo Is.).

**Remarks.** In the genus *Microarthridion* Lang, 1944, six species are currently recognized: *M. littorale* (Poppe, 1881), *M. reductum* (Monard, 1935), *M. berberum* (Monard, 1936), *M. fallax* Perkins, 1956, *M. litospinatus* Shen and Tai, 1973 and *M. corbisierae* Kihara and Rocha, 2007. In having the character combination of antennary exopod with 5 setae and P2-P3 enp 2 each with 2 inner setae, *M. litospinatus* most resembles *M. reductum*. However, *M. litospinatus* differs from *M. reductum* as well as other congeneric species by the armature of endopodal lobe of P5 in both sexes (cf. Fig. 3D, F, arrows), that is, 3 stout pinnate setae and a minute spine between the innermost and median setae, as indicated in the specific name. *Microarthridion littorale*, reported from Europe, North America, and East Asia (China and Sakhalin) is easily distinguished from *M. litospinatus* by the number of setae on antennary exopod (4 in *M. littorale*, while 5 in *M. litospinatus*), and the setal armature of 4 pinnate setae (similar in shape to each other) on endopodal lobe of female P5.

This is the first record of *M. litospinatus* outside the type locality, southern China. Korean specimens precisely fit with the original description (Shen and Tai, 1973), except for the shape and location of the dorsal and lateral caudal setae, which should have been inadequately described, considering the typical pattern of this genus.

Genus <sup>1</sup>*Geeopsis* Huys, 1996

<sup>2</sup>*Geeopsis incisipes* (Klie, 1913) (Figs. 6, 7)

*Tachidius incisipes* Klie, 1913, p. 38; Gurney, 1932, p. 28; Lang, 1948, p. 294; Dussart, 1967, p. 175.

*Geeopsis incisipes*: Huys, Gee, Moore and Hamond, 1996, p. 228, figs. 87C-E, 90.

**Material examined.** Two ♀♀, estuary of Nakdong R., Busan estuary (Hadandong), 27 Apr. 1985 (C.Y. Chang).

**Diagnosis.** Cyclopoid-like in appearance; cephalothorax with dorsal median nuchal organ; prosomites and pediger 5 with paired accessory nuchal organs laterally (Fig. 6A, arrow); rostrum small, not protruding, not defined at base; genital somite and first abdominal somite divided (Fig. 6A); anal operculum with spinule row along posterior margin (Fig. 6B); lateral caudal seta (caudal seta II) locating at proximal two-fifth of lateral margin of Fu; A1 (Fig. 6C) 9-segmented in female, with setal formula 1-[1], 2-[9], 3-[8], 4-[5+aesthetasc], 5-[2], 6-[4], 7-[2], 8-[2], 9-[6+aesthetasc]; A2 exopod (Fig. 6D) 2-segmented, proximal segment with 2 setae, distal segment with 3 well-developed plumose setae; maxilla (Fig. 6E), syncoxa with 3 endites, each bearing 3 setal elements; maxilliped (Fig. 6F) subchelate, basis unarmed, endopod 1-segmented with elongated claw and 1 small seta distally; P1 (Fig. 6G) swimming leg, enp 1 of normal size with inner seta, exp 3 with 6 setae/spines in total; P2-P4 (Fig. 7A-C), both rami 3-segmented, enp 1 of normal size with inner seta; P2-P3 enp 2 with 2 inner setae; female P5 (Fig. 6A) bilobed, with 4 pinnate setae on inner lobe, 5 setae including outer basal seta (3 pinnate and 2 slender setae) on outer lobe.

**Ecology.** Euryhaline species, collected from estuary and inlet; known as rare or occasional (Huys et al., 1996).

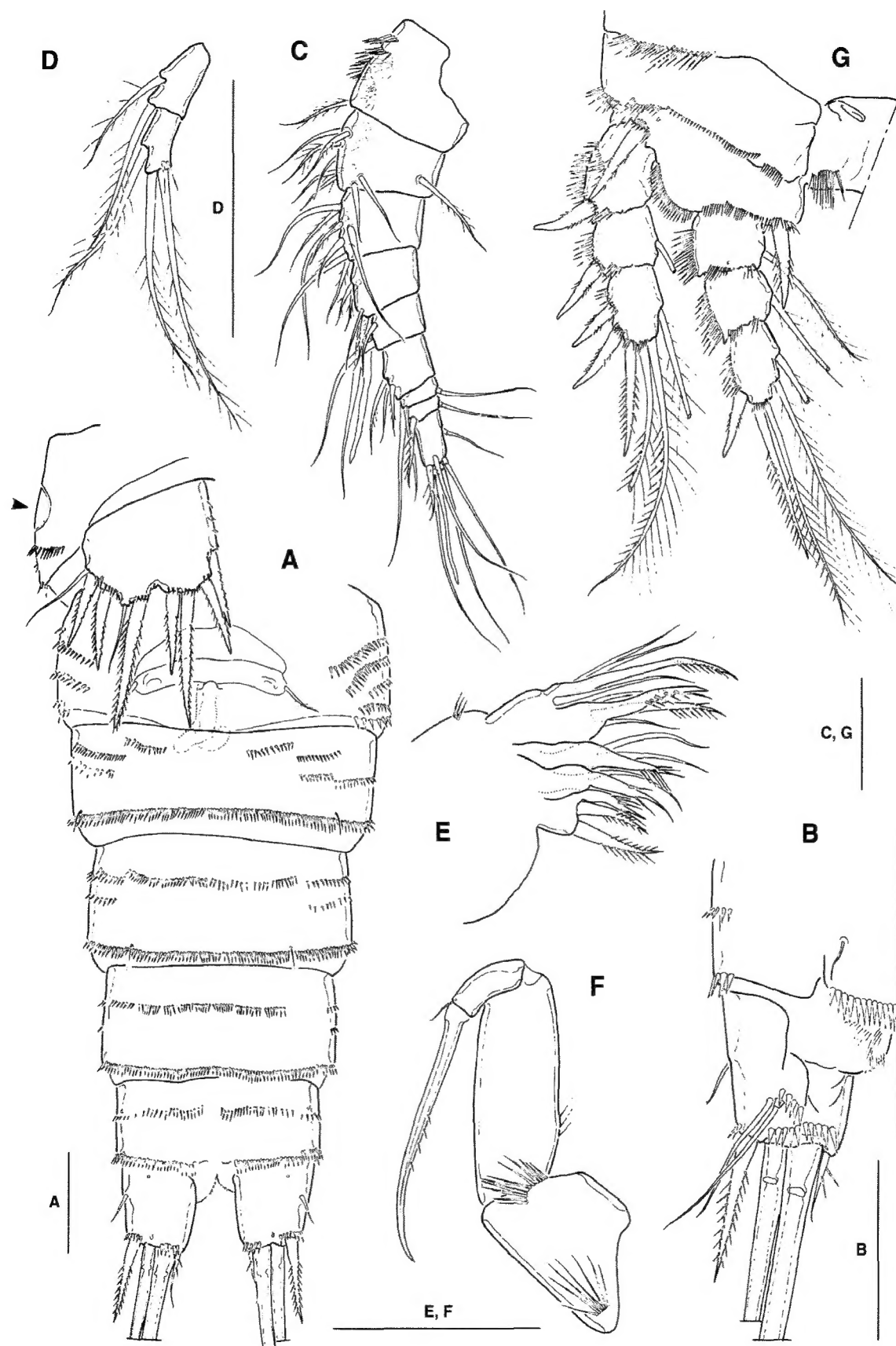
**Distribution.** North Sea (U.K., Germany, Spitzbergen) and Korea (Busan).

**Remarks.** Two female specimens examined coincide well with the original description (Klie, 1913) and redescrptions (Gurney, 1932; Dussart, 1967; Huys et al., 1996) from the North Sea. The number of setae on the distal segment of antennary exopod is known as variable, 3 or 4 (Lang, 1948; Dussart, 1967; Huys et al., 1996). Both Korean specimens examined have 3 setae. Moreover, the number of setae on the P4 enp 2 also shows the variation of 1 or 2 in Korean specimens, as in the cases of 1 in Klie (1913) and 2 in Gurney (1932).

#### A key to the genera and species of the family Tachidiidae from Korea

1. P1 exp 3 with 5 setae/spines in total ..... 2

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**Fig. 6.** *Geeopsis incisipes* (Klie), female. A, urosome and P5, ventral; B, anal somite and caudal ramus, dorsal; C, A1; D, A2 exopod; E, maxilla; F, maxilliped; G, P1. Scale bars=50  $\mu$ m (A-G).

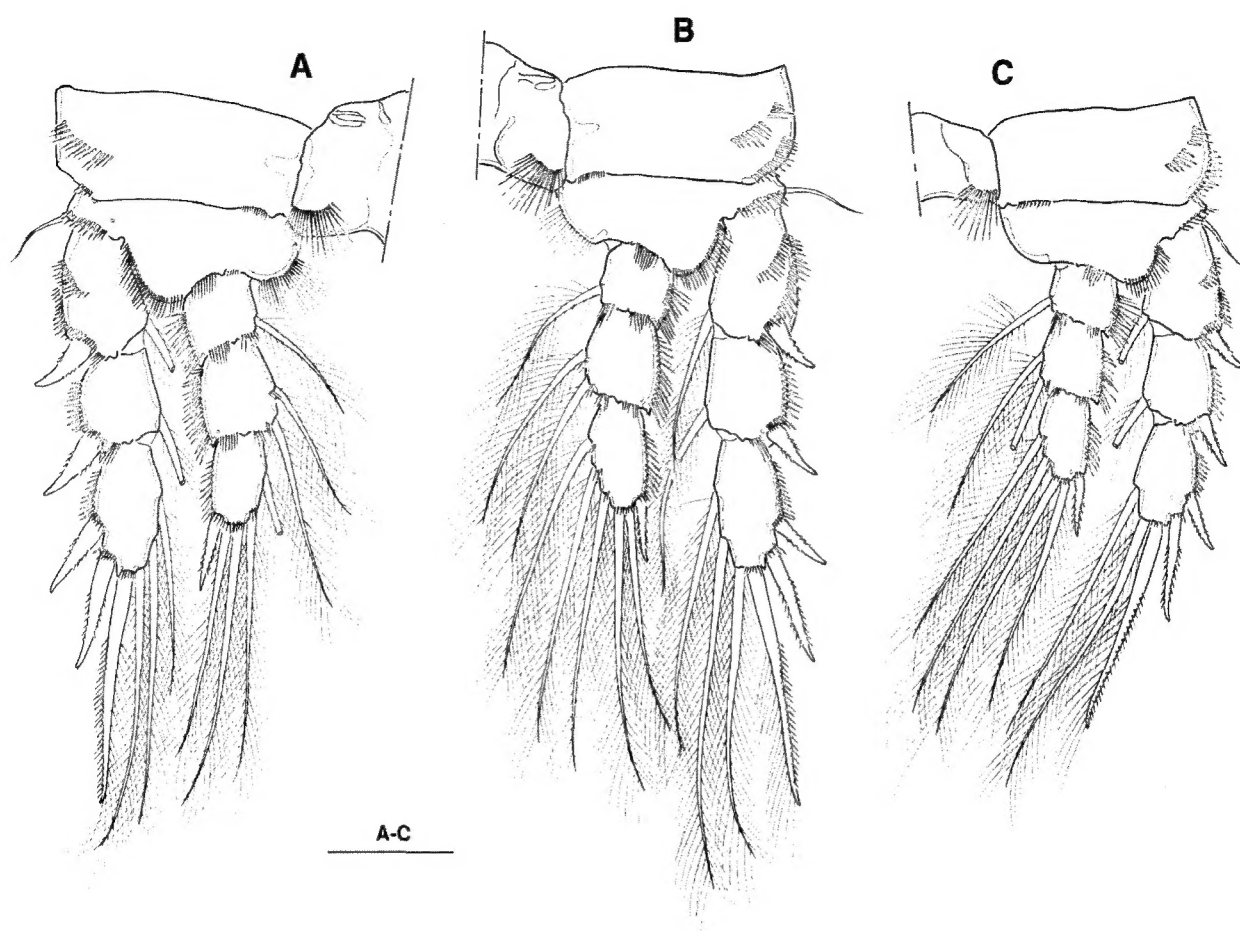


Fig. 7. *Geeopsis incisipes* (Klie), female. A, P2; B, P3; C, P4. Scale bar=50  $\mu$ m.

- P1 exp 3 with 6 setae/spines in total ..... 4
2. P5 bilobate; P1 enp 3 with 1 spine and 4 setae .....  
*Tachidius discipes*  
 P5 triangular; P1 enp 3 with 1 spine and 3 setae .....  
 ..... 3 (genus *Neotachidius*)
3. Body small (about 0.5 mm long); last segment of A1 about 1.2 times longer than the preceding segment; distal seta on P1 enp 3 plumose, nearly as long as inner distal seta; female P5 elongate (length to width ratio about 1.4) .....  
 ..... *N. parvus*  
 Body relatively big (about 0.7 mm long); last segment of A1 about twice as long as the preceding segment; distal seta on P1 enp 3 pinnate, much shorter than inner distal seta; female P5 nearly forming regular triangle (length to width ratio nearly 1) ..... *N. coreanus*
4. Genital somite and first abdominal somite divided; pediger 5 with accessory nuchal organ; P1-P4 enp 1 normal, with inner seta; P4 enp 2 with 2 inner setae; female P5 bilobed, with 4 pinnate setae on inner lobe .....  
 ..... *Geeopsis incisipes*  
 Genital somite and first abdominal somite fused to geni-

tal double-somite; pediger 5 without accessory nuchal organ; P1-P4 enp 1 reduced, without inner seta; P4 enp 2 with 1 inner setae; inner lobe of female P5 with 3 pinnate setae and 1 short spine ..... *Microarthridion litospinatus*

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